Magnetic Resonace Imaging Study in Major Psychiatric Disorders

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Magnetic resonance brain imaging provides good contrast between the three principal compartments of the brain: gray and white matter, and cerebrospinal fluid (CSF). Not only brain volumic and structural understanding, the application of magetic imaging techniques as in Functional MRI (fMRI), Magnetic resonance spectroscopy (MRS) also has greatly enhanced the range of findings in brain function of psychiatric patients.

The objective of this paper was to present a brief review of the technological advances in magnetic neuroimaging, and to indicate how these techniques have impacted the study of psychiatry.

Reviews of recent researchs, examples of imaging techniques, and major findings for schizophrenia, affective disorder, anxiety, personality and other major psychiatric disorders are offered. In summary,the using of magnetic neuroimaging as an aid to diagnosis is discussed, and findings from the most accessible imaging techniques are reviewed.

Keywords : *Magnetic Resonance Imaging, MRI, fMRI, MRS Psychiatry, Schizophrenia, Affective, Anxiey, Personality*

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Advanced functional imaging techniques now make it possible to study in vivo the relationship between altered cerebral activation patterns and the psychopathologic and cognitive features of psychiatric disorders. There is a renewed interest in the further elucidation of the etiopathogenesis of some psychiatric disorders and clinical-radiological correlations are increasingly reported. Volume measurements by MRI are frequently used and functional MR imaging (fMRI) offers new approaches to research questions in psychiatry that could not have been addressed earlier by positron emission tomography and single photon emission CT. Study designs involving fMRI absence of radiation exposure [1, 2].

MRI is marked by excellent overall resolution, the capability to image most of the brain's structures (an important advantage in the study of the neurobiology of psychiatry), and by its largely noninvasive nature. Examples of recent findings and clinical applications illustrate actual cases and examples of the newer imaging technologies [3].

Magnetic Resonance Imaging (MRI):

Magnetic Resonance Imaging (MRI) is a non-invasive procedure that uses powerful magnets and radio waves to construct pictures of the body. Unlike conventional radiography and Computed Tomographic (CT) imaging, which make use of potentially harmful radiation (X-rays), MRI imaging is based on the magnetic properties of atoms.

MRI has a number of safety issues, including the effects of high magnetic fields and radiofrequency pulses on the body, and on implanted devices, the side effects of contrast agents, toxicity during pregnancy and claustrophobia [4].

Functional MRI (fMRI):

Functional MRI (fMRI) is a technique that localizes brain activity by imaging the influence of blood concentrations of deoxyhemoglobin, which alters signal through magnetic field changes. Recent advances in MRI image detect levels of oxygenated hemoglobin in the blood. Neuronal activites within the brain can be calculated by the amount the oxygen use [5].

FMRI study in Schizophrenia and Major depression, fMRI investigate brain activation in patients with schizophrenia and major depression while they performed two tasks- a vigilance task and a mental arithmetic task-that differed in cognitive complexity. The results showed that schizophrenia had less activa-

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tion in prefrontal brain regions, relative to the comparison participants. A double dissociation of parietal and frontal lobe activation was found for schizophrenia patients and depression patients [6].

Magnetic resonance spectroscopy (MRS):

Magnetic resonance spectroscopy is a complex and sophisticated neuroimaging technique that allows reliable and reproducible quantification of brain neurochemistry. Neurochemical changes have been found in a variety of brain regions in dementia, schizophrenia and affective disorders and promising discoveries have also been made in anxiety disorders [7].

MRI in Special Psychiatric Disorder

1. Schizophrenia

Schizophrenia is a serious brain disorder. It is a disease that makes it difficult for a person to tell the difference between real and unreal experiences, to think logically, to have normal emotional responses to others, and to behave normally in social situations. Investigators have used MRI in schizophrenia research because its resolution is superior to that with CT such as the reduction of hippocampus-amygdala complex, the reduction of left hemisphere.The studies have correlated the reduction in limbic system volume with the degree of severity of illness.

In adult schizophrenia, magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS) have revealed volumetric and metabolic defects in multiple brain regions, among them the anterior cingulate, frontal cortex, striatum, thalamus, parietal cortex, and frontal and parietal white matter [8].

1.1 MRI findings

Anterior cingulate cortex: The human anterior cingulate cortex (ACC), is active during conflict-monitoring tasks. One fMRI study reported evidence of structural and functional abnormalities in the anterior cingulate cortex of patients with schizophrenia [9].

Prefrontal cortex: A recent fMRI study found the pattern of prefrontal cortex underactivation and parahippocampal overactivation in patients suggested that functional connectivity of dorsolateral prefrontal and temporal-limbic structures is disrupted by schizophrenia. This disruption may be reflected in the memory strategies of patients with schizophrenia, which include reliance on rote rehearsal rather than associative semantic processing [10].

Gray matter: Olfactocentric paralimbic regions, play crucial roles in human emotion and motivation, and a study using MRI found a bilateral volume reduction in insular cortex gray matter was specific to first-episode patients with schizophrenia [11].

The significant increases in cortical folding were observed in the right superior frontal cortex in first episode schizophrenic patients.Significant main effects of hemisphere were found in frontal, parietal, and occipital regions in directions complementary to cerebral torques.This finding supports the theory of neurodevelopmental origin in schizophrenia that frequency of cortical folding seems to be disturbed during gyral formation in utero [12].

Thalamus: Thalamic volume was smaller than normal in schizophrenia patients, but only proportionate to reductions in reduced total cerebral volume. The presence of changes in thalamic shape and asymmetry suggest greater pathologic involvement of individual nuclei at its anterior and posterior extremes of the thalamic complex [13].

Corpus Collosum: First episode schizophrenia patients showed reductions in signal intensity in all the callosal subregions, the genu, body, rostrum and splenium. Schizophrenia is characterized by pathology of this principal interhemispheric commissure; the abnormalities may reflect distributed (rather than localized) interhemispheric disconnectivity that extends beyond the heteromodal association cortices [14].

Hippocampus: One study found volume reductions in most hippocampal subregions of schizophrenic patients. Analysis data revealed significant alterations of the inter-voxel coherences in single hippocampal subdivisions of these patients, supporting the assumption of characteristic microstructural tissue changes relevant for the pathogenesis of schizophrenic psychoses [15].

Basal Ganglion: Schizophrenia patients showed features of increased metabolism in the basal ganglia consistent with impaired activity of the frontostriatal pathways. A recent study using MRS to investigate basal ganglia abnormalities in neuroleptic-naive patients with schizophrenia demonstrated that the phosphocreatine/total phosphorus and phosphocreatine/total ATP ratios in both basal ganglia were significantly lower in these patients [16].

Ventricle Enlargement: The longitudinal study of first-episode patients with schizophrenia who had serial MRI scans during the first 5 years of illness. Greater enlargement of lateral ventricles and reduction of hemispheric volume was observed over time in the patients compared with controls [17].

1.2 Schizophrenia in special attentions

High genetics risk for schizophrenia: Studies

of high-risk offspring of schizophrenic patients have found abnormalities in attention, working memory and executive functions, suggesting impaired integrity of the prefrontal cortex and related brain regions. The fMRI study in the high-risk offspring showed significant decreases in fMRI-measured activation in the dorsolateral prefrontal cortex and the inferior parietal cortex. Abnormal functional integrity of prefrontal and parietal regions of the heteromodal association cortical regions in subjects at genetic risk for schizophrenia is consistent with findings observed in adults with the illness [18].

Audiotory Hallucination: The abnormalities in auditory cortex structure and function, particularly in the superior temporal gyrus (STG) is the cause of audiotory hallucination symptoms in schizophrenia. Synchronous hemodynamic independent maps by MRI in schizophrenia suggests that aberrant patterns of coherence in temporal lobe cortical regions are a cardinal abnormality in schizophrenia [19].

Smooth persuit eye movement: Smooth pursuit deficits were assessed outside the fMRI apparatus by using infrared oculography and were assessed during scanning by evaluating echo-planar time-series data from the eyes. Schizophrenia may have diminished inhibitory function in the hippocampus as well as for a disturbance in a frontotem-poral network subserving smooth pursuit eye movements [20].

1.3 Brain metabolic change in Schizophrenia

N-acetylaspartate (NAA): NAA, a neuronal marker, may be an indicator of disease severity of positive symptoms. There was a significant correlation between NAA concentration and social functioning within the schizophrenic group. However, a study using MRS to measure NAA for evaluate the neuronal integrity of the dorsolateral prefrontal region in negative symptoms schizophrenic demonstrated a significant negative correlation between severity of symptoms and NAA concentration [21].

Another MRS study in schizophrenia showed a significant correlation between the low ratio amplitudes between metabolites and creatine plus phosphocreatine (Cr) (NAA/Cr) and age of onset of illness in the hippocampus. This findng reflected a neurodegenerative process in hippocampus [22].

Choline (CHO): The neurodegenerative brain metabolism in schizophrenia show decrease of NAA, increase of CHO and a cerebral asymmetry of these metabolites. MRS studies of schizophrenia suggest high choline levels in the caudate nucleus and demonstrate that high caudate choline levels in schizophrenia are not secondary to antipsychotic treatment [23].

Glutamate: A recent study using MRS investigation of glutamate and glutamine in adolescents at high genetic risk for schizophrenia found that Glutamate/glutamine was significantly higher in the adolescents at high genetic risk for schizophrenia than in the low-risk offspring. This finding supported both the glutamate dysfunction and neurodevelopmental hypotheses for schizophrenia [24].

Phospholipid: The study of phospholipid metabolism change in first-episode schizophrenia using 31P-MRS showed increased levels of glycerophosphocholine in the anterior cingulate. Inorganic phosphate, phosphocreatine and adenosine triphosphate concentrations were also increased in the anterior cingulate. This finding may indicate neural overactivity in this region during the early stages of the illness, resulting in increased excitotoxic neural membrane breakdown [25].

2. Affective disorder

Depression may be described as feeling sad, blue, unhappy, miserable, or down in the dumps. After establishing socio-demographic and psychological risk factors for depression, epidemiological research has focused on biological factors. The most consistent finding in biological psychiatry is the disturbance of the hypothalamic-pituary-adrenal axis in depressed persons [26].

Silent brain infarcts and cerebral white matter lesions on MRI were found to be more frequent in the depressed patient than in controls. Cerebral small vessel disease has been rediscovered as a potential cause of depression [27]. With the advances in high-resolution MRI and fMRI studies, structural neuroimaging changes in mesial temporal structures, prefrontal cortex and basal ganglia were found in major depressive disorders [28].

2.1 MRI findings:

MRI studies in depressed subjects report smaller volumes of amygdala, hippocampus, inferior anterior cingulate, and the orbital prefrontal cortex, components of the limbic-cortico-thalamic circuit. Depressed females had smaller amygdala than males and this may correlate with the higher rate of depression in women [29].

Hippocampus: The effect of depression on the hippocampus has become the focus of a number of structural and functional neuroimaging studies. MRI volumetric measurement have reported decreases in hippocampal volume among depressed subjects and appears to have functional significance including an association with memory loss (pseudodementia) [30, 31].

Orbitofronal: The orbitofrontal cortex plays a major role in neuropsychologic functioning including exteroceptive and interoceptive information coding, reward-guided behavior, impulse control, and mood regulation. Patients with depressive disorder have reduced orbitofrontal gray matter volumes in MRI findings [32].

Pituitary gland: Pituitary gland volume measured by MRI in the concept of abnormalities in pituitary function have been described in major depressive disorder showed that age was significantly correlated with pituitary volume in the healthy controls but not a major depressive disorder and no significant relationships between pituitary size and clinical severity were found in the depressive patients [33].

Temporal lobe: In depressed patients the left temporal horn was 49.8% and the right 38.4% larger in comparison with the control group [34].

Basal ganglia: The abnormalities in lateralization and possibly neurodegenerative changes in basal ganglia structures participate in the pathophysiology of major depressive disorder [35].

Cortical gray matter: The brain size reduction of the orbitofrontal cortex and to the gray matter abnormalities detected in orbitofrontal cortex and temporoparietal cortices in elderly depression [36].

2.2 Depressive disorder in special attention

Depressive disorder with suidial idea: White matter hyperintensities may be used as the biological markers associated with increased risk of suicide. In children and adolescents unipolar depression, white matter hyperintensities were significantly associated with a higher prevalence of past suicide attempts [37].

Female major depression: MRI studies in depressed subjects report smaller volumes of the limbic-cortico-thalamic circuit (amygdala, hippocampus, inferior anterior cingulate, and the orbital prefrontal cortex). Major depression occurs more commonly in women, the biology of mood disorders in females may differ in some aspects from males. Depressed females but not depressed males had smaller amygdala compared with controls. Sex may affect volumetric deficits in amygdala and anterior cingulate cortex in mood disorders, but no effects were found in the hippocampus or orbital prefrontal cortex [38].

Depressive disorder with sexual problems: The study of sexual response in depressed patients by fMRI showed lower level of activation during the visually evoked sexual arousal especially in the cerebrocortical areas of the hypothalamus, thalamus, caudate nucleus, and inferior and superior temporal gyri [39].

Elderly depression: The elderly are at high risk for depression because they are more likely than younger people to have experienced illness, death of loved ones, impaired function and loss of independence. There is a relationship between MRI cerebrovascular disease lesion severity and mortality among geriatric depressed patients [40]. Late-onset depressive disorder is associated with white matter lesions and neuropsychological deficits that in some studies are linked to a poorer outcome for depression [41].

Bipolar depression: Bipolar disorder is characterized by periods of excitability (mania) alternating with periods of depression. The study used fMRI while viewing alternating situations designed to evoke negative, positive or no affective change in bipolar depressws patients. The activation in patients, when compared with healthy subjects, involved additional subcortical regions, in particular the amygdala, thalamus, hypothalamus and medial globus pallidus. Bipolar depressed patients may recruit additional subcortical limbic systems for emotional evaluation and this may reflect state-related or trait-related dysfunction [42].

3. Anxiety Disorder

Anxiety is a feeling of apprehension or fear. Anxiety disorders are a group of psychiatric conditions that involve excessive anxiety. Inborn individual differences in stress prone to respond to enviroment are associated with persistent differences in the responsivity of the amygdala, as measured with fMRI. Because an inhibited temperament is a risk factor for developing later psychiatric disorders, particularly generalized social anxiety disorder, temperamental differences are confounds in neuroimaging and genetic studies [43].

3.1 Generalized Anxiety Disorder (GAD):

The common symptoms of generalized anxiety disorder (GAD) are intrusive worry about everyday life circumstances and social competence, and associated autonomic hyperarousal. The amygdala, a brain region involved in fear and fear-related behaviors in humans and animals. MRI was used to measure the amygdale, superior temporal gyrus, thalamus, and prefrontal volumes in subjects with generalized anxiety disorder. Larger amygdala volumes were reported in pediatric GAD [44].

3.2 Obsessive-compulsive disorder (OCD):

OCD is an anxiety disorder characterized by obsessions or compulsions. An obsession is a recurrent and intrusive thought, feeling, idea, or sensation. A compulsion is a conscious, recurrent pattern of behavior

a person feels driven to perform. The study by MRI showed that the measurements of the area of the head of the caudate nucleus, cingulate gyrus thickness, intracaudate/frontal horn ratio, and area of the corpus callosum seem to be normal [45].

The obsessive-compulsive symptoms may be mediated by relatively distinct components of fronto-striatothalamic circuits implicated in cognitive and emotion processing which showed in the fMRI study that patients demonstrated significantly greater activation than controls in bilateral ventromedial prefrontal regions and right caudate nucleus (washing); putamen/globus pallidus, thalamus, and dorsal cortical areas (checking); left precentral gyrus and right orbitofrontal cortex (hoarding); and left occipitotemporal regions (aversive, symptom-unrelated) [46].

3.3 Panic disorder:

Panic disorder involves repeated, unpredictable attacks of intense fear accompanied by severe anxiety symptoms in the body that may last from minutes to hours. Panic patients have a decreased volume of the left temporal lobe measured by MRI and indicate the presence of volumetric abnormalities of temporal lobe structures [47].

3.4 Phobia:

A phobia is a persistent and irrational fear of a particular type of object, animal, activity or situation. Neuroimaging research has helped to advance neurobiological models of anxiety disorders. The amygdala is known to play an important role in normal fear conditioning and is implicated in the pathophysiology of anxiety disorders [48].

The role of the amygdala in fear processing study show significantly increased amygdala, insula, orbitofrontal cortex, uncus activation in spider phobics, during presentation of phobia-relevant visual stimuli [49]. The psychotherapeutic approach, such as CBT, has the potential to modify the dysfunctional neural circuitry associated with anxiety disorders. The amygdala may also be a target for the beneficial effects of cognitive-behavioral and medication treatments for anxiety disorders [50].

3.5 Posttraumatic stress disorder (PTSD):

PTSD can occur following a traumatic event in which there was threat of injury or death to you or someone else. The neural correlates of traumatic memory in PTSD using fMRI revealed activation of orbitofrontal cortex areas in both hemispheres, anterior temporal lobes, and occipital areas, right more than left activation of anterior temporal lobes, mesiotemporal areas, amygdala, posterior cingulate gyrus, occipital areas, and cerebellum [51].

The amygdala appears to be hyperreactive to trauma-related stimuli. The hallmark symptoms of PTSD, including exaggerated startle response and flashbacks, may be related to a failure of higher brain regions (i.e., the hippocampus and the medial frontal cortex) to control the exaggerated symptoms of arousal and distress that are mediated through the amygdala in response to reminders of the traumatic event [52].

4. Personality Disorder

Personality disorders are a group of psychiatric conditions marked by chronic behavior patterns that cause serious problems with relationships and work. The behavioral inhibition system was associated with activity in numerous brain areas in response to fear, disgust, and erotic visual stimuli, whereas few associations could he detected between the behavioral approach system and brain activity in response to disgust and erotic stimuli [53].

4.1 Schizoid personality disorder:

Schizoid personality disorder is a personality problem characterized by a lifelong pattern of indifference to others and social isolation. The shape of the head of the caudate nucleus with MRI in schizotypal personality disorder subjects with no prior neuroleptic exposure history had significantly higher head of the caudate shape index scores, lateralized to the right side. The higher right and left head of the caudate SI scores correlated significantly with poorer neuropsychological performance on tasks of visuospatial memory and auditory/verbal working memory. These data support the association of intrinsic pathology in the caudate nucleus, unrelated to neuroleptic medication, with cognitive abnormalities in the schizophrenia spectrum [54].

4.2 Schizotypal personality disorder:

Schizotypal personality disorder is a psychiatric condition characterized by a pattern of deficiency in interpersonal relationships and disturbances in thought patterns, appearance, and behavior. Schizotypal personality disorder showed reduced prefrontal gray volumes and poorer frontal functioning compared to normal. Structural prefrontal deficits have been reported in patients with schizophrenia and schizophrenia spectrum personality [55].

4.3 Borderline personality disorder BPD:

BPD is a condition characterized by impulsive actions, mood instability, and chaotic relationships. The study of fMRI regional cerebral hemodynamic changes in patients with BPD after viewing emotionally aversive slides revealed activation of the amygdala and

fusiform gyrus in the patients [56].

Pictures of human emotional expressions elicit robust differences in amygdala activation levels in borderline patients, compared with normal control subjects, and can be used as probes to study the neuropathophysiologic basis of borderline personality disorder [57].

4.4 Antisocial personality disorder:

Antisocial personality disorder is a personality disorder characterized by chronic behavior that manipulates, exploits, or violates the rights of others. This behavior is often criminal. High rates of neuropsychiatric abnormalities reported in persons with violent and criminal behaviour suggest an association between aggressive dyscontrol and brain injury, especially involving the frontal lobes. Focal orbitofrontal injury is specifically associated with increased aggression. Clinically significant focal frontal lobe dysfunction is associated with aggressive dyscontrol [58].

Psychopathy is associated with right hemisphere abnormalities for processing conceptually abstract material. Analysis of fMRI findings was associated with neural activation that psychopathic individuals fail to show the appropriate neural differentiation between abstract and concrete stimuli in the right anterior temporal gyrus and surrounding cortex [59].

5. Other Clinical attentions

5.1 Organic Mental Disorder

Traumatic brain injury: Major depression is a frequent psychiatric complication among these patients. Major depression ater traumatic brain injury was associated with poorer social functioning at the 6-and 12-month follow-up, as well as significantly reduced left prefrontal gray matter volumes, particularly in the ventrolateral and dorsolateral regions. The neuropathological changes lead to deactivation of lateral and dorsal prefrontal cortices and increased activation of ventral limbic and paralimbic structures including the amygdala [60].

Dementia and Mild cognitive impairment: MRI volumectric assessment of medial temporal lobe atrophy can predict dementia in patients with mild cognitive impairment. Visual assessment of medial temporal lobe atrophy with MRI is an independent predictor of conversion to dementia in relatively young mild cognitve impairment patients [61].

5. 2. Substance Related Disorder

Alcohol: Alcohol dependence patients compared to social drinkers had increased differential brain activity observed by fMRI in the prefrontal cortex, anterior limbic regions and anterior thalamus after being exposed to alcohol cues. Alcoholism has brain metabolite changes that are associated with lower brain function and are likely to be of behavioral significance [62].

Amphetamine: In chronic methamphetamine users, MRI cortical maps revealed severe gray matter deficits in the cingulate,limbic, and paralimbic cortices. Methamphetamine abusers had smaller hippocampal volumes and significant white-matter hypertrophy. Chronic methamphetamine abuse causes a selective pattern of cerebral deterioration that contributes to impaired memory performance [63].

The popular recreational drug, 3,4-methylenedioxymethamphetamine (MDMA,Ectasy) exerts its actions in part via blockade of serotonin and dopamine reuptake. Several brain regions having decreased gray matter concentration in MDMA polydrug users. MDMA polydrug users have multiple regions of gray matter reduction [64].

5.3 Child psychiatry

The availability of non-invasive brain imaging permits the study of normal and abnormal brain development in childhood and adolescence. Attention deficit hyperactivity disorder is characterized by a slightly smaller total brain volume (both white and grey matter), less-consistent abnormalities of the basal ganglia and a striking decrease in posterior inferior cerebellar vermal volume [65]. Childhood onset schizophrenia has smaller brain volume due to a 10% decrease in cortical grey volume and nucleus accumbens [66].

5.4 PsychoOncology

MRI has been used for detection of brain metastasis in cancer patients, but is also useful for evaluation of stressful events by measuring the sizes of tiny neural structures such as hippocampus and amygdala [67].

Conclusion

The revolution in the in vivo imaging of the body's internal structures that began with the classic X-rays has progressed to the advanced stage of magnetic technology which permits detailed imaging of soft tissue and many of its attributes. MRI is marked by excellent overall resolution, the capability to image most of the brain's structures (an important advantage in the study of the neurobiology of psychiatry), and by its largely noninvasive nature.

By studying correlations in the fMRI signal across different brain regions, the functional connectivity between those brain regions can be assessed. Magnetic resonance spectroscopy provide information

about neurochemical abnormalities in the brain.

In schizophrenia, magnetic resonance imaging techniques have demonstrated volumetric and metabolic defects in multiple brain regions, among them the anterior cingulate, frontal cortex, striatum, thalamus, parietal cortex, and frontal and parietal white matter.

MRI and fMRI studies of depressive disorder show structural neuroimaging changes in mesial temporal structures, prefrontal cortex and basal ganglia. Compared with anxiety disorder, the studies revealed the importance of amygda as the pathogenesis of anxiety symptoms.

Findings in personality disorder demonstrated the behavioral inhibition system associated with activity in numerous brain areas in response to fear, disgust, and erotic visual stimuli. Other clinical attentions in psychiatry such as organic mental disorder,substance related disorder,child psychiatry and psychoonchology were discussed.

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การศึกษาการถ่ายภาพการตรวจสมองด้วยคลื่นแม่เหล็กไฟฟ้าในโรคจิตเวชศาสตร์ที่สำคัญ

เดชา ลลิตอนันต์พงศ์, ศิริพร ลลิตอนันต์พงศ์

การตรวจการถ่ายภาพสมอง ด้วยการใช้เครื่องตรวจสมองด้วยคลื่นแม่เหล็กไฟฟ้า (Magnetic Resonance Imaging, MRI) สามารถให้ข้อมูลที่ชัดเจน ทั้งในส่วน เนื้อสมอง และน้ำในสมอง สามารถให้ข้อมูลทั้งในด้านเนื้อสมอง โครงสร้างสมอง นอกจากนี้การใช้เครื่องมือตรวจสมองด้วยคลื่นแม่เหล็กไฟฟ้า ยังมีชนิด Functional MRI (fMRI) และ Magnetic resonance spectroscopy (MRS) ทำให้ค้นพบการเปลี่ยนแปลงของหน้าที่การทำงานในสมองของผู้ป่วยโรคจิตเวชได้

รายงานฉบับนี้มีวัตถุประสงค์ที่จะทบทวน ความก้าวหน้าทางการใช้ การถ่ายภาพการตรวจสมองด้วยเครื่องตรวจสมองด้วยคลื่นแม่เหล็กไฟฟ้า และอธิบายถึงความสัมพันธ์กับการศึกษาในวิชาจิตเวชศาสตร์

การทบทวนการวิจัยใหม่ๆ ตัวอย่างเทคนิค และ ผลที่ตรวจพบในผู้ป่วย เช่น โรคจิตเภท โรคอารมณ์ โรควิตกกังวล ปัญหาบุคลิกภาพแปรปรวน และ โรคที่สำคัญอื่น ๆ ทางจิตเวชศาสตร์

สรุป การถ่ายภาพโดยการใช้เครื่องมือตรวจสมองด้วย คลื่นแม่เหล็กไฟฟ้า สามารถช่วยในการวินิจฉัย และสามารถใช้ประโยชน์จาก ทบทวนผลที่พบจากการใช้เครื่องมือตรวจสมอง ด้วยคลื่นแม่หล็กไฟฟ้าชนิดต่าง ๆ